Puchkov and Timusk Reply: Combining our own optical measurements and those of several other labs we showed that infrared conductivity spectral weight (SW) increases with T_c in underdoped high-T_c cuprates but *saturates* above the optimal doping. In their Comment Kendziora *et al.* argue that a thin-crystal transmission measurement, in an unusually highly doped sample of Bi2212, suggests an *increase* in SW in contradiction with our finding. The results of Kendziora *et al.* [1] are interesting and should be pursued further, but their interpretation is not straightforward for the following reasons.

First, in Fig. 1 we plot the high-frequency (Fig. 1 in the Comment [1]) and the low-frequency transmission results (Ref. [2]). There is a large disagreement between the two data sets. Both sets are marked by the authors as obtained on $T_c = 60$ K (oxygen-annealed) and $T_c = 85$ K (air-annealed) crystals, implying that the material (if not the actual crystals) was the same. No single multiplication coefficient, such as crystal thickness, can bring the two sets of data in agreement with each other. If one multiplies the high-frequency curves by *different* coefficients in an attempt to remove the discontinuity, one finds that the transmission doping dependence can be accounted for by a constant plasma frequency and a decreasing with overdoping scattering rate—in agreement with our findings. Next [3], following the authors of the Comment, we obtain a ratio of the dc resistivities at $T = 300$ K from the transmission data: $[t(0)^{\mathrm{air}}/t^{\mathrm{oxygen}}(0)]^{1/2} = \rho_{\mathrm{dc}}^{\mathrm{air}}/\rho_{\mathrm{dc}}^{\mathrm{oxygen}} = 1.22$. Contrary to what the authors claim, this ratio is in *disagreement* with the directly measured ratio 1.73 [2]. The Hall effect results (Ref. [5] in the Comment) are irrelevant since no overdoped samples were measured. A fit [2,3], similar to the one used by the authors of the Comment, gives a 50% increase in the scattering rate of the oxygen annealed sample. This is contrary to a general trend that overdoping decreases a scattering rate [4,5], and suggests a large increase in an impurity concentration.

We do not wish to discard the results obtained on $La_{2-x}Sr_xCuO_4$ as irrelevant since the relation between T_c and x is very well established for this system. For example, a *measured* decrease of T_c with overdoping from 27 to 22 K (more than 20%) to 0 K produced less than a 2% change in SW. No significant increase in the (low frequency) SW can be seen in the results by Prenninger *et al.* obtained on $T_c = 70$ K overdoped Bi2212 [6].

Other experiments support our observation that the SW stops increasing at optimal doping. Fukuzumi *et al.* suggested that while the carrier concentration increases in the underdoped regime, it decreases in the overdoped regime [7]. Photoemission results suggest that the Fermi surface volume increases with doping in the underdoped regime but decreases in the overdoped regime [8]. In fact, since the (holelike) Fermi surface of the optimally doped cuprates occupies almost a half of the Brillouin zone, suggested doubling of the carrier density will change its topology to *electron*-like. Therefore, one should not expect a "*continuation of the trends seen in underdoped samples*," but a rather significant change.

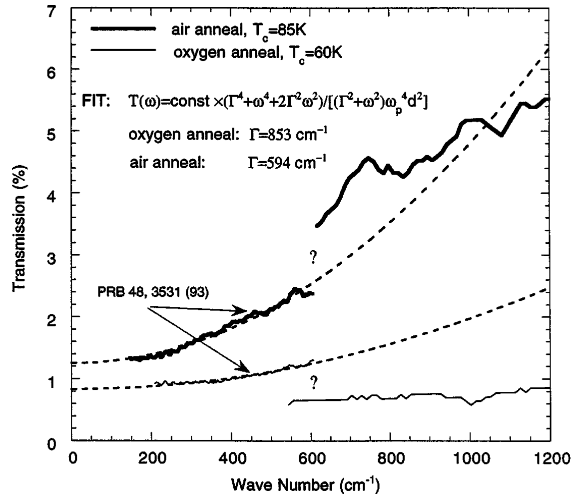

FIG. 1. The high-frequency and the low-frequency sets of transmission curves by Kendziora *et al.* Also shown are our fit to the low-frequency results and the parameters obtained.

One hypothetical scenario in which the *ab* plane SW may suddenly increase in Bi2212 is the one in which the BiO planes become conducting. Unfortunately, the transmission results by Kendziora *et al.* do not allow us to confirm or rule out this possibility since the error bars are too large. More work should be done on obtaining optical constants over a larger frequency region.

A. V. Puchkov[1] and T. Timusk[2]
[1]Department of Applied Physics, Stanford University
Stanford, California 94305-4045
[2]Department of Physics, McMaster University
Hamilton, Ontario, Canada L8S4M1

Received 14 April 1997 [S0031-9007(97)04684-X]
PACS numbers: 74.62.Dh, 74.25.Fy, 74.25.Gz

[1] C. Kendziora *et al.,* preceding Comment, Phys. Rev. Lett. **79**, 4935 (1997).
[2] C. Kendziora *et al.,* Phys. Rev. B **48**, 3531 (1993).
[3] D. Mandrus *et al.,* Phys. Rev. Lett. **70**, 2629 (1993).
[4] A. V. Puchkov *et al.,* J. Phys. Condens. Matter **8**, 10 049 (1996).
[5] S. Uchida *et al.,* Phys. Rev. B **43**, 7942 (1991).
[6] M. Prenninger *et al.,* Physica (Amsterdam) **235-240C**, 1131 (1994).
[7] Y. Fukuzumi *et al.,* Phys. Rev. Lett. **76**, 684 (1996).
[8] Z.-X. Shen *et al.,* Science **267**, 343 (1995); A. Ino *et al.* (unpublished).

